CATALOG DOCUMENTATION
MAIA-ESTUARIES SUMMARY DATABASE
1997 and 1998 STATIONS
BENTHIC SUMMARY DATA: "BENSUMRY"

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1. DATASET IDENTIFICATION

1.1 Title of Catalog document
   MAIA-Estuaries Summary Database
   1997 and 1998 Stations
   Benthic Summary Data

1.2 Authors of the Catalog entry
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1.3 Catalog revision date
   April 30, 2000

1.4 Dataset name
   BENSUMRY

1.5 Task Group
   MAIA Estuaries

1.6 Dataset identification code
   011

1.7 Version
   001

1.8 Request for Acknowledgment
   EMAP requests that all individuals who download EMAP data acknowledge the source of these data
   in any reports, papers, or presentations. If you publish these data, please include a statement similar
   to: "Some or all of the data described in this article were produced by the U. S. Environmental
   Protection Agency through its Environmental Monitoring and Assessment Program (EMAP)".

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2.3 Sample Processing Investigators
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3. DATASET ABSTRACT

3.1 Abstract of the Dataset
The BENSUMRY file presents a summary of selected benthic abundance and biomass data that were collected in MAIA estuaries during the Summers of 1997 and 1998. Seventeen summary parameters are reported for each sampling event at a station. The parameters include the mean abundances per grab of infaunal species, epifaunal species, spionid polychaetes, and tubificid oligochaetes (calculated separately); the mean biomass per grab of all species; the total and mean numbers per grab of infaunal species and epifaunal species (calculated separately); and three indices characterizing the condition at the site: the Shannon-Weiner, Gleason's D, and EMAP VA Province Benthic indices. One record is presented for each site visit. The complete records of benthic abundance and biomass data are contained in the BEN_ABUN and BEN_BIOM files, respectively.

3.2 Keywords for the Dataset
Benthic species, invertebrates, epifaunal, infaunal, spionid polychaetes, tubificid oligochates, Shannon-Weiner, Gleason's D, EMAP VA Province Benthic Index, mean abundance per grab, mean biomass per grab

4. OBJECTIVES AND INTRODUCTION

4.1 Program Objective
The main objectives of the MAIA-Estuaries program are: (1) to evaluate the ecological condition of the Mid-Atlantic estuaries by measuring key properties of the water, sediment, and the community of organisms; (2) to focus attention on small estuaries in order to develop better monitoring approaches for these critical systems; and (3) to develop partnerships among federal and state environmental organizations.

The Environmental Monitoring and Assessment Program (EMAP) is an EPA research and monitoring program designed to provide unbiased assessments of the condition of selected resources over a wide region. A key feature of the program is a probabilistic sampling strategy that randomly selects sampling sites and assigns weighting factors based on area to all measured results. EMAP's strategy was adopted by the Mid-Atlantic Integrated Assessment (MAIA) program, which was designed to assess the conditions of the estuaries, forests, streams and lakes, and

agricultural lands in the eight-state Mid-Atlantic region. This file contains data measured in MAIA estuaries during the Summers of 1997 and 1998. Samples were collected for water and sediment analyses primarily in 1997, with a few additional sites sampled in 1998. Fish samples were collected only in 1998. Several estuaries were designated as intensive sites and were sampled in greater detail (see STATIONS file).

The partners in MAIA-Estuaries program are: (1) The U.S. Environmental Protection Agency (USEPA), including both the Atlantic Ecology Division (AED) and the Gulf Ecology Division (GED); (2) National Park Service (NPS) under their project "Maryland Coastal Bays Monitoring"; (3) National Oceanographic and Atmospheric Administration (NOAA) which conducted sampling both in the Delaware Bay (DB) under their "National Status and Trends Program" and in the Carolinian Province (CP); and (4) The Chesapeake Bay Program (CBP), which is a consortium of federal, state, and local governments and nongovernmental organizations. Each partner was responsible for collecting, processing, and reviewing data. The USEPA Atlantic Ecology Division was responsible for final assembly and review of all data. Laboratories contracted to process samples are specified by the parameter LABCODE included in all data files (Section 4.4).   Details regarding use of partner and LABCODE information are presented in the EVENTS metadata file.

4.2 Dataset Objective
This file presents summary parameters and indices calculated from benthic abundance and biomass data collected in MAIA estuaries in during the Summers of 1997and 1998.

4.3 Dataset Background Discussion
The data files BEN_ABUN and BEN_BIOM contain extensive records reporting the abundance and biomass of benthic invertebrate organisms in MAIA sediments. However, it is often useful to summarize some of this information to aid in its interpretation. This file reports several simple averages of abundance and biomass data, as well as three indices that express the diversity of species in a community. Infaunal species refer to organisms living within the sediments. Epifaunal organisms live at the sediment/water interface. The summary parameters include the mean abundances per grab of infaunal species, epifaunal species, spionid polychaetes, and tubificid oligochaetes (calculated separately); the mean biomass per grab of all species; and the total and mean numbers per grab of infaunal species and epifaunal species (calculated separately). The three indices are the Shannon-Weiner index, Gleason's D index, and the EMAP VA Province Benthic index. The expressions used to calculate these indices are presented in Section 6.2.

The Shannon-Weiner index, H', is a standard measure of species diversity that ranges from zero to positive values, representing progressively increasing diversity (Krebs, 1989). Gleason's D index is an expression of species diversity, also ranging from near zero to positive values, with larger values signifying greater diversity. The EMAP Virginian Provence Benthic Index is a combination of three metrics into a single index (the metrics are: salinity-adjusted Gleason's index, the salinity-adjusted abundance of tubificids, and the abundance of spionids). This Benthic Index was developed with data compiled during the 1990-1993 EMAP effort in the Virginian Provence (Paul *et al.* 1999.   The majority of values range from -5 to +5, with positive values signifying healthy conditions and negative values indicating degraded conditions.

4.4 Summary of Dataset Parameters
*STATION	Station name
*EVNTDATE	Event date
A_SAMPS	Number of grabs with abundance data
INF_ABU	Mean abundance per grab, all infauna
EPI_ABU	Mean abundance per grab, all epifauna
SPIONID	Spionid polychaetes (infaunal species only), mean abundance/grab
TUBIFIC	Tubificid oligochates, mean abundance/grab
B_SAMPS	Number of grabs with biomass data

4.4 Summary of Dataset Parameters, continued
        MN_BIOM   Mean biomass per grab, all species
        TSINFCNT   Total number of infaunal species
        TSEPICNT   Total number of epifaunal species
        MSINFCNT   Mean number of infaunal species per grab
        MSEPICNT   Mean number of epifaunal species per grab
        SHANNON3   Shannon-Wiener Index - all species
        GLEASON3   Gleason's D - all species
        BOT_SAL   Bottom salinity used in calculating benthic index. Most values are as reported in
                        the WATRPHYS file, but some missing values in Delaware Bay were
                        interpolated from data at neighboring sites. The interpolated data are denoted
                        with a QACODE = BI-A.
        PEXP_GL3   Salinity normalized Gleason's D
        PEXP_TUB   Salinity normalized tubificid abundance
        B_IND94B   EMAP VA province benthic index
        QACODE   QA qualifier
                        <blank> No qualification
                        BI-A   Salinity values used in calculating Benthic Index are interpolated
        LABCODE   Contract / lab identifier
                        BEN-1 USEPA contractor: Versar, Inc.
                        BEN-2 NOAA Carolinian Province contractor
                        BEN-3 Chesapeake Bay Program contractor: Versar, Inc.
                        BEN-4 NOAA Delaware Bay contractor
        YEAR   Year of Sampling: 1997 or 1998

    * denotes parameters that should be used as key fields when merging data files

5. DATA ACQUISITION AND PROCESSING METHODS
    All values in this data file were calculated from data presented in the BEN_ABUN and BEN_BIOM
    data files. Refer to the metadata for those files for details regarding sampling and processing
    methods.

6. DATA ANALYSIS AND MANIPULATIONS

6.1 Name of New or Modified Values
        SHANNON3   Shannon-Wiener Index - all species
        GLEASON3   Gleason's D - all species
        PEXP_GL3   Salinity normalized Gleason's D
        PEXP_TUB   Salinity normalized tubificid abundance
        B_IND94B   EMAP VA province benthic index

6.2 Data Manipulation Description
        The <u>Shannon-Wiener Index</u>, SHANNON3, was calculated as:
                $H' = -3P_i*log(10)P_i$
        where P_i is the fraction of the total abundance attributed to the *i*th species, and log(10) denotes
        log base 10. All species reported at a station (infaunal and epifaunal) were included.

        The <u>Gleason's D Index,</u> GLEASON3, for infaunal and epifaunal species was calculated as:
                D = (total # species)/(natural log of total abundance)
        All species reported at a station were included.

        The <u>salinity-normalized Gleason's Index</u> was calculated as the ratio of the *measured* and

expected Gleason's D indices, reported as a percent (Paul *et al*., 1999). The expected index is calculated:

$$PEXP\_GL3 = GLEASON3/(4.283 - 0.498*sal + 0.0542*sal^2 - 0.00103*sal^3)*100$$

where 'sal' is the bottom water salinity.

The salinity-normalized tubificid abundance was calculated as (Paul *et al*., 1999):

$$PEXP\_TUB = \text{measured tubificid abundance} - 500*exp(-15*sal)$$

where 'sal' is the bottom water salinity.

The EMAP VA Province Benthic Index, B_IND94B, was developed as described by Paul *et al*., (1999). The coefficients of the expression differ depending on the number of grabs analyzed at a station. Where one grab sample was analyzed, the benthic index (BI) was calculated as:

$$BI = 1.389*(PEXP\_GL3 - 51.5) / 28.4 - 0.651*(PEXP\_TUB - 28.2) / 119.5 - 0.375*(\text{spionid abundance} - 20.0) / 45.4;$$

Where either 2 or 3 grabs samples were analyzed, the BI was calculated as :

$$BI = 1.246*(PEXP\_GL3 - 40.5) / 25.3 - 0.555*(PEXP\_TUB - 29.1) / 124.7 - 0.344*(\text{spionid abundance} - 20.0) / 52.0;$$

PEXP_GL3 is the salinity-normalized Gleason's D index, and PEXP_TUB is the salinity-normalized tubificid abundance.

7. DATA DESCRIPTION

7.1 Description of Parameters

7.1.1 Components of the Dataset

STATION	Station name
EVNTDATE	Event date
A_SAMPS	Number of grabs with abundance data
INF_ABU	Mean abundance per grab, all infauna
EPI_ABU	Mean abundance per grab, all epifauna
SPIONID	Spionid polychaetes (infaunal species only), mean abundance/grab
TUBIFIC	Tubificid oligochates, mean abundance/grab
B_SAMPS	Number of grabs with biomass data
MN_BIOM	Mean biomass per grab, all species
TSINFCNT	Total number of infaunal species
TSEPICNT	Total number of epifaunal species
MSINFCNT	Mean number of infaunal species per grab
MSEPICNT	Mean number of epifaunal species per grab
SHANNON3	Shannon-Wiener Index - all species
GLEASON3	Gleason's D - all species
BOT_SAL	Bottom water salinity
PEXP_GL3	Salinity normalized Gleason's D
PEXP_TUB	Salinity normalized tubificid abundance
B_IND94B	EMAP VA province benthic index
QACODE	QA qualifier
LABCODE	Contract / lab identifier
YEAR	Year of sampling

7.1.2 Precision of Reported Values

PARAMETER	PRECISION	MIN	MAX	UNITS
A_SAMPS	unit	1	3	number of grabs
INF_ABU	0.1	0	2720	organisms per grab
EPI_ABU	0.1	0	928	organisms per grab
SPIONID	0.1	0	296	organisms per grab

7.1.2 Precision of Reported Values

PARAMETER	PRECISION	MIN	MAX	UNITS
TUBIFIC	0.1	0	1860	organisms per grab
B_SAMPS	unit	1	3	number of grabs
MN_BIOM	0.0001	0	10.8	gram per grab
TSINFCNT	unit	0	55	number of species
TSEPICNT	unit	0	33	number of species
MSINFCNT	0.1	0	35	species per grab
MSEPICNT	0.1	0	19.5	species per grab
SHANNON3	0.001	0	1.42	no units
GLEASON3	0.01	0	11.5	number of species
BOT_SAL	0.1	0	35	ppt
PEXP_GL3	0.1	0	124	no units
PEXP_TUB	0.1	-493	1860	organisms per grab
B_IND94B	0.01	-8.87	5.01	no units

7.1.3 Minimum Value in Dataset
See Section 7.1.2.

7.1.4 Maximum Value in Dataset
See Section 7.1.2.

7.2 Data Record Example

7.2.1 Column Names for Example Record
See Section 7.2.2.

7.2.2 Example Data Records

STATION	EVNTDATE	A_SAMPS	INF_ABU	EPI_ABU	SPIONID	TUBIFIC
MA97-0001	8/25/97	2	141.5	1.0	52.0	0.0
MA97-0003	8/26/97	2	58.0	6.5	11.5	0.0
MA97-0004	8/26/97	2	59.5	4.5	7.5	0.0
MA97-0005	8/27/97	2	136.0	6.0	10.5	0.0

B_SAMPS	MN_BIOM	TSINFCNT	TSEPICNT	MSINFCNT	MSEPICNT	SHANNON3
2	0.1051	16	1	12.0	0.5	0.788
2	0.0623	26	6	16.5	3.0	1.305
2	0.0307	14	1	10.5	1.0	0.944
2	0.0445	27	6	18.5	3.0	1.034

GLEASON3	BOT_SAL	PEXP_GL3	PEXP_TUB	B_IND94B	QACODE	YEAR
3.01	30.1	29.2	0.0	-1.20		1997
6.58	27.2	65.1	0.0	0.89		1997
3.09	26.0	31.3	0.0	-0.73		1997
5.84	28.3	57.0	0.0	0.50		1997

8. GEOGRAPHIC AND SPATIAL INFORMATION

8.1 Minimum Longitude (Westernmost)
-77.4339 decimal degrees

8.2 Maximum Longitude (Easternmost)
-74.7230 decimal degrees

8.3 Minimum Latitude (Southernmost)
34.9670 decimal degrees

8.4 Maximum Latitude (Northernmost)
40.1470 decimal degrees

8.5 Name of area or region
MAIA estuary region, consisting of Delaware Bay, Chesapeake Bay, the Delmarva coastal bays, Albemarle-Pamlico Sound, and contiguous estuaries.

9. QUALITY CONTROL AND QUALITY ASSURANCE

All values in this data file were calculated from data presented in the BEN_ABUN and BEN_BIOM data files. Refer to the metadata for those files for details regarding sampling and processing methods.

9.1 Measurement Quality Objectives
Not applicable

9.2 Data Quality Assurance Procedures
Not applicable

9.3 Actual Measurement Quality
Not applicable

10. DATA ACCESS

10.1 Data Access Procedures
Data can be downloaded from the web

10.2 Data Access Restrictions
None

10.3 Data Access Contact Persons
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10.4 Dataset Format
ASCII (CSV) and SAS Export files

10.5 Information Concerning Anonymous FTP
   Not available

10.6 Information Concerning WWW
   See Section 10.1 for WWW access

10.7 EMAP CD-ROM Containing the Dataset
   Data not available on CD-ROM

11. REFERENCES

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Paul, J.F., J.H. Gentile, K.J. Scott, S.C.Schimmel, D.E. Campbell, and R.W. Latimer. 1999. EMAP-Virginian Province Four-Year Assessment Report (1990-93). EPA 600/R-99/004. U.S. Environmental Protection Agency, Atlantic Ecology Division, Narragansett, Rhode Island.

Strobel, C.J. 1998. Mid Atlantic Integrated Assessment / Environmental Monitoring and Assessment Program - Estuaries: Virginian Province Quality Assurance Project Plan. U.S. EPA, Office of Research and Development, NHEERL-AED, Narragansett, RI. June 1998.

12. TABLE OF ACRONYMS

AED	Atlantic Ecology Division
BI	Benthic Index
CP	Carolinian Province
CBP	Chesapeake Bay Program
D	Gleason's D Index
DB	Delaware Bay
EMAP	Environmental Monitoring and Assessment Program
EPA	U.S. Environmental Protection Agency
GED	Gulf Ecology Division
GERG	Geochemical and Environmental Research Group
H'	Shannons-Weiner Index
MAIA	Mid-Atlantic Integrated Assessment
NHEERL	National Health and Environmental Effects Research Laboratory
NOAA	National Oceanic and Atmospheric Administration
NOS	National Ocean Service
NPS	National Park Service
ODU	Old Dominion University
ORCA	Office of Ocean Resources Conservation and Assessment
ORD	Office of Research and Development
QA/QC	Quality Assurance/Quality Control
TAMU	Texas A&M University
TOC	Total Organic Carbon
USEPA	United States Environmental Protection Agency
VER	Versar, Inc.
WWW	World Wide Web

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